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Abstract — Urban and periurban agricultural producers have faced many stressors – both negative ones and positive ones – particularly from the mid-20th century onwards. They have included urban development pressures, exurban development, the evolving markets for the products of these producers – food and other products, and environmental challenges stemming from farming's own technologies. More recently, these stressors have been compounded by climate change and variability. The importance of the decision processes at the local level (i.e. individual farmers and producers, local government, various community organisations, and citizens more generally) and how such decision makers adapt to the various stressors has been increasingly recognised. In relation to urban and periurban farm producers, more and more attention has been placed on the adaptive capacity of these decision makers to maintain and develop their own production systems. At the same time, there has been an increase in the environmental services that these areas are expected to perform mainly by the urban citizenry, thus reinforcing the multi-functionality of the areas concerned. In this paper, we argue that developing producers' adaptive capacity is one of the keys to contributing to alleviating food insecurity, but at the same time, the multi-functionality of these same areas provides a powerful tool with which to maintain and develop the strength of food production through having non farm actors and citizens appropriate the importance of conserving agricultural production – and therefore food production – in these same areas to contribute in a sustainable fashion to improving food security both regionally, domestically and internationally.

Key words: food security, environmental stress, multi-functionality

Résumé — Les producteurs agricoles des milieux urbains et périurbains sont confrontés depuis longtemps à des pressions de nature diverse, tant positives que négatives, p. ex. la pression foncière, les variations sur les marchés agricoles, et les défis environnementaux résultant des changements technologiques et de l'évolution des pratiques agricoles. Plus récemment encore, le changement et la variabilité climatiques sont venus se greffer à la liste de ces pressions. Nos travaux ont démontré l'importance des processus décisionnels à l'échelle locale et la façon dont ces acteurs s'adaptent à ces différentes pressions. Pour les producteurs agricoles urbains et périurbains, un accent particulier a été mis sur leur capacité adaptative relative au maintien et au développement de leurs propres systèmes de production. D'autre part, il y a eu une reconnaissance grandissante des services environnementaux que peuvent fournir ces milieux dans le contexte de leur multifonctionnalité. Nous nous penchons sur les questions touchant à la capacité adaptative des acteurs locaux. Nous postulons que si l'adaptation apparaît comme une dimension majeure afin d'assurer la sécurité alimentaire, la multifonctionnalité se révèle comme tout aussi importante. En effet, de plus en plus, les attentes de la part des citadins concernant les espaces agricoles vont au-delà de la production elle-même, contribuant ainsi à la sensibilisation des acteurs non agricoles à l'importance de conserver ces espaces et leur capacité de production. L'adaptation au changement et à la variabilité climatiques ainsi que la multifonctionnalité apparaissent donc comme des éléments majeurs pouvant contribuer durablement à l'amélioration de la sécurité alimentaire à toutes les échelles régionales, nationales qu'internationale.

Mots clé: sécurité alimentaire, stress environnementaux, multifonctionnalité

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INTRODUCTION[1]

Agriculture, particularly agriculture in the context of Canada's metropolitan and major urban regions, is one of the cornerstones of our society. As in many other developed societies, it has already had to adapt to numerous stressors since the middle of the 20th century. Adaptation is partly the responsibility of individual farmers and their families; it is also partly a responsibility of other actors, notably governments, local and regional municipalities, professional (agricultural) groups and community organisations. This more collective responsibility is evident as soon as it is realized that the many stressors affects not only agricultural resources, but also other resources required by the non farm community such as water resources and landscape values. This implies that adaptation is required by all users of these shared resources.

In North America and in Canada in particular, the conservation of agricultural land in the face of urban development pressures has long been a preoccupation of many governments, particularly at the edge of the expanding urban area and extending into the urban fringes of major cities (for instance in several U.S states, and in Canada, in British Columbia since 1973 and in Quebec since 1978) (Bryant and Johnston, 1992; Bryant and Granjon, 2007). Initially, conserving food producing land could be seen as reflecting an article of faith on the part of those governments and other actors who have supported farmland protection programs, particularly given the various forms of subsidies given to food producers in Western Europe in particular and the tendency over the last few decades for food production to move into an oversupply mode in relation to market needs. Urban agriculture (UNDP, 1996), on the other hand, with its stronger focus on responding to certain social needs was frequently regarded as being marginal in terms of food production.

This situation we argue has now fundamentally changed for two sets of reasons: 1. the growing attention in Canada given to the multi-functional production of goods and services supported by food production areas (both in urban and periurban contexts) (formally later

[1] The research reported upon in this paper is based upon two streams of research: 1. urban and periurban agriculture extending over some 40 years, but more recently upon research being undertaken in Quebec under a Social Sciences and Humanities Research Council (SSHRC) research grant involving research action to contribute to the revitalisation of vulnerable urban and periurban agricultural areas (this involves the team of Bryant and Chahine in Quebec, as well as a research team based in Paris dealing with similar issues in the Île-de-France region (Université Paris X, École Nationale Supérieure du Paysage de Versailles and ENGREF Clermont-Ferrand)); and 2. agricultural adaptation to climate change and adaptation in Quebec for the last 20 years and, since 2009, Ontario, also under a SSHRC grant. The climate change adaptation research team has also involved Bhawan Singh from the Université de Montréal during the whole of this period, and Paul Thomassin from McGill University for the last 5 years, and Michael Brklacich from Carlton University, Ottawa, since 2009. The climate change adaptation research involves a combination of the construction of climate scenarios into the medium term using relatively localised data, using a crop growth model to assess the consequences of different climate scenarios on selected crop yields, using focus groups with farmers and professionals associated with farming to assess the reasonableness of the scenarios and their crop yield consequences, interviews with farmers as well as the focus groups to identify alternative adaptive strategies (individual and collective), and finally using farm models for specific farm types in the selected study regions to assess the consequences of adopting certain adaptive strategies.

than in Western Europe, even though the English language literature dealt with the concept with other terminology, notably 'multi-purpose use' (Bryant et al., 1982)); and 2. the changing role in terms of food production that is increasingly attached to urban and periurban agri-food production because of the differential effects of climate change on agricultural productivity for agricultural areas located near major cities compared with areas to the south and in many developing countries (Bryant et al., 2007a, b).

On the one hand, and in the context of adaptation, we argue that innovative strategies are likely to become more important in taking advantage of the multi-functionality of urban and periurban land, which will help more actors and the population at large appropriate the need to conserve food production land so that it can take on a more central role in feeding the regional urban population. On the other hand, innovative strategies by producers are also needed in order to adapt proactively to the stressors generated by climate change and uncertainty. Furthermore, it is argued that there is a need to enhance the adaptive capacity of producers as well as a number of other actors locally and regionally. In order to achieve this, it is argued that senior governments can play an important role in enhancing adaptive and innovative capacity through appropriate programs that build upon the capacities of other local and regional actors. Food security is an important consideration from all of these perspectives.

Our objective is to take a non traditional perspective on the trials and tribulations of food production and its potentials in urban and periurban contexts by focussing on the role of the individual food producer and his or her adaptive and innovative capacity in the face of:

1. well-known stresses and opportunities (e.g. urbanisation, urban markets) and those that emerge from emerging opportunities related to the multi-functionality of these spaces (e.g. environmental services supported by food production areas) and to the growing consumer market for organically and locally produced produce; and
2. more recent challenges emerging from the effects of climate change and uncertainty on agricultural productivity and food production systems and the likely changes in the relative competitiveness of different food production territories (regions, countries).

First, we review briefly the various pressures or stressors on urban and periurban agriculture. Then, we develop the argument that it is absolutely critical to understand the local arena as the scale at which the most significant adaptations and innovations can make a difference. We then review the importance of understanding the multi-functionality of these urban and periurban spaces and territories, from the perspective of maintaining and developing the role of these spaces and territories in contributing to alleviating food insecurity. We end by drawing conclusions on the implications for research and on the roles of different actors in maintaining and developing the roles of these agricultural production spaces and territories.

1. PRESSURES ON URBAN AND PERIURBAN AGRICULTURE

Urban development pressures on agriculture and the high quality agricultural resources that are found around many major metropolitan and urban regions in Canada (Bryant, 1976; Bryant et al., 1982) were mainly responsible for the development of the two provincial level initiatives of legislation for the protection of farmland in the provinces of British Columbia (1973) and Quebec (1978). Curiously, while research on the impacts of urban development on periurban agriculture was substantial in Ontario in the 1950s and 1960s, no similar program for the protection of farmland around Ontario's major cities was established. Recently, the government of Ontario has developed a major greenbelt in the Golden Horseshoe area near Toronto in which one of the consequences will be to establish greater protection for farmland in the zone (Bunce, 2008; Caldwell et al., 2007)

Not only are there urban development pressures, urban and periurban agricultural producers have faced many other stressors – both negative ones and positive ones – particularly from the mid-20th century onwards. These include exurban development in the broader urban field, the evolving markets for the products of these producers – food and other products, and environmental challenges stemming from farming's own technologies. More recently, these stressors have been compounded by climate change and variability.

By way of example, in terms of the urban market for foodstuffs, there has been increasing attention given to a developing segment of the market to purchase food that is 'locally' produced – e.g. the '100 mile radius' movement (e.g. Smith and Mackinnon, 2007), similar to the *locavore* movement in France. This is frequently, but not always, linked to organic farm production. There is clearly an environmental component to these movements, both in terms of actual production processes (hence the emphasis on organic production) and the hoped-for reduction in the transportation costs of moving food produce from the farm to the market. The environmental preoccupations of an increasing number of urban consumers also extend to concerns over the negative externalities generated by productivist farming on the environment (e.g. water pollution and erosion), frequently finding expression in the often presumed incompatibilities between modern farming and non farm residential development.

Climate change and its associated increased variability in climate conditions represent arguably the single largest challenge to Canadian agriculture in the coming decades. The issue of adaptation of agriculture to climate change and variability has become a major research field in Canada (Bryant et al., 1997, 2000; Bryant et al., 2007a, b, 2008; Dolan et al., 2001). Clearly, we are all aware of the fact that agriculture is affected directly by climate conditions and that it is a crucial economic activity that contributes to the welfare of society at all scales. Since 2007, food shortages became a prominent feature of debate in the media and by governments worldwide. Food shortages were attributed to several factors, such as climate change, increasing drought conditions in some developing countries, the diversion of important cropland areas to bio-fuel production in some countries (e.g. the US), and changing food demand by growing middle classes in India and China's emerging economies.

However in the many agricultural areas close to major urban areas in Canada (e.g. Montréal, Toronto and south-west Ontario generally, Vancouver) where the agricultural conditions currently are very favourable for agricultural production (both in terms of soil and climate conditions, as well as agricultural structures), climatic conditions will not be impacted as seriously as agricultural areas in more southerly locations in North America and in many developing countries. This, it is argued, will increase the pressure on these areas not only to adapt effectively to the changing climate conditions, but also to contribute in a more significant manner to alleviating food insecurity in other regions and countries. It therefore can be argued that this will increase the pressure on governments to reinforce programs for the protection of productive farmland in periurban areas as well as spaces that can support urban agriculture, in order to better ensure that they can contribute to alleviating food insecurity at all scales, given that levels of food insecurity will likely worsen in many parts of the world.

2. LOCAL DECISION PROCESSES, ADAPTATION AND INNOVATION

In North America, decision processes at the local level (i.e. individual farmers and producers, local government, various community organisations, and citizens more generally) have been increasingly recognised as significant to the shaping of our economy and society at regional, state/province and national levels (Bryant and Cofsky, 2004). As a corollary of this, how such decision makers adapt to the various stressors has been increasingly recognised as well. In relation to urban and periurban farm producers, more and more attention has been placed on the adaptive capacity of these decision makers both to maintain and develop their own production systems. In effect, it has even been recognised that without effective local initiatives in farm production (i.e. including innovative adaptation strategies) particularly in periurban contexts (but also in several urban contexts, where there remains significant farmland either being farmed or still in agricultural land protection reserves), it appears unlikely that farmland protection programs can operate successfully in the long term (Bryant and Granjon, 2007; Caldwell et al., 2007).

Interestingly enough, adaptation of farming systems and farmers specifically was analysed for periurban farming early on in France in the Île-de-France region (Bryant, 1970). This subsequently led to a conceptualisation that began to address the heterogeneity of farmers' adaptation strategies or lack of, with farm areas being conceptualised into three broad categories: degenerating farm landscapes; adapting farm landscapes; and farm landscapes undergoing a 'normal' pattern of farm transformation (Bryant, 1984).

In urban spaces and periurban territories, the difficulties of identifying effective adaptation strategies are compounded by the complexities of the stressors in the farm producer's decision making environment. Not only must farmers grapple with adapting to climate change, but they must also contend simultaneously with competition and concerns from urban areas for various resources – e.g. land for development, competition for water resources, maintenance of water quality.

3. MULTIFUNCTIONALITY AND CONSERVATION OF LAND FOR FOOD PRODUCTION

Some of these concerns relate to an increase in the environmental services that these agricultural production areas are expected to perform mainly by the urban citizenry, thus reinforcing the multi-functionality of the areas concerned (Bryant, 2007, 2009). This multi-functionality can be quite complex, but it is also, we argue, one of the tools that can facilitate the conservation of farmland (see below). Responding to all of these demands in appropriate ways requires innovative and proactive adaptation.

We argue that developing producers' adaptive capacity is one of the keys to contributing to alleviating food insecurity, but at the same time, the multi-functionality of these spaces and territories provides a powerful tool for maintaining and developing the strength of food production. This is by encouraging (if it is not happening 'naturally') (e.g. Planchenault, 2008) non farm actors and citizens to appropriate the importance of conserving agricultural production resources – and therefore food production potential – in these same areas thereby contributing in a sustainable fashion to improving food security both regionally, domestically and internationally. This is important if we accept that food security is a major world issue (Mougeot, 2006; FAO, 2008, 2009). At the same time, effective adaptive strategies (e.g. introducing better suited cultivars, engaging in more effective water management strategies on the farm or collectively in farm areas) can help reduce vulnerability to climate change (Brklacich, 2006; Brklacich and Bohle, 2006; Delusca, 2010).

Furthermore, urban agriculture producers such as people who produce from community gardens (St-Amour, 2010; Délavar, 2007; Ville de Montréal, 2005) need also to be able to adapt to changing conditions around their production areas.

The multi-functional character of many urban and periurban agricultural spaces and territories, some of which are in effect enclaves in the urban area, is becoming increasingly managed as an integral part of the city for the benefit of both the agricultural producers and the urban citizenry, as in the *ville-campagne* project of the City of Longueuil (e.g. Planchenault, 2008) and the agricultural reserves in the City of Laval on the northern side of the Montreal agglomeration. Such projects are however not without their difficulties, as senior governments' objectives and interpretations of the imperatives of farmland protection or management do not necessarily coincide with those of local actors – farmers, citizen groups and local governments.

4. CONCLUSIONS

Periurban agriculture can be seen as a strategically important territory for the many functions it plays for the urban population (Charvet and Bryant, 2003). Periurban territories and urban agriculture spaces form an integral part of the city region, hence why the term 'The City's Countryside' was coined in the early 1980s (Bryant et al., 1982). Together with the spaces for urban agriculture, they support many functions that contribute to the quality of life in those city regions for the urban population, the exurban population and for the rural, including agricultural, population.

The results from the two research thrusts identified in the Introduction and in footnote (1) both stress the significance of local processes, adaptation and innovation. In the case of the periurban agriculture project, projects are emerging that have either been appropriated by the farmers themselves or in one case, that of Senneville in the west of the Île-de-Montréal, actually initiated by them. For the project that has been evolving in the municipality of Senneville, the research process has led to: 1. a much broader territorial project than that based just on the agriculturally used spaces; 2. the appropriation and involvement of a substantial number of non farm actors in this larger project because of its multi-functional nature, e.g. including conserving green open space, the ecological value of the land and the recreational values embedded in the area for the surrounding urban population.

In the case of the climate change and variability adaptation projects, the research process has involved and is involving interactions with the farmers and other professionals associated with agriculture. The research process has led to: 1. the modification of the crop models that were linked to the climate scenarios because of the integration of farmers' local knowledge; 2. the identification of potential adaptation strategies individually or collectively, particularly including strategies based on water management; and 3., as a result of the frequent identification of the importance of improved water management adaptive strategies, the initiation of a new research program in 2009 aimed specifically at agricultural territories in periurban or otherwise urbanising areas where water management is a significant issue.

Both of these research thrusts come together in periurban agricultural territories and urban agriculture spaces. Both of these research thrusts have as their integrating research approach an action research stance. This mode of undertaking research is effective for tackling research questions that are critical to society and necessitate the involvement of non researchers in the search for solutions and more effective research approaches. Research action whereby the researcher plays out the roles of accompanying a process involving other actors, counselling them, providing them with strategic information and facilitating interactions among the actors has important links with the emerging roles of governments in

relation to local development and as well the roles of effective local development officers (Bryant and Cofsky, 2004; Bryant el al., 2009). The ultimate result of this research action stance is, it could be argued, the importance of co-construction of collective intervention, with 'collective' involving non government actors and government actors working together to deliver an appropriate set of interventions to create sustainable production spaces and territories for the production of food as well as supporting the many other functions that ensure the permanency of these spaces and territories.

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